

the larger States to be, Ohio, 54; Indiana, 49; Iowa, 42; Missouri, 44. The very largest States have a small frequency, viz, Texas, 7; New Mexico, 10; and California, 14. Florida is credited with only 8, which may be due to the sparseness of observers, but is quite as likely to be a real phenomenon due to the insular character of the climate over the greater part of the peninsula.

TABLE 2.—Monthly frequency of hailstorms, in decimals of the annual total.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Alabama.....	.06	.06	.17	.17	.16	.13	.04	.07	.04	.01	.03	.04
Arizona.....	.04	.08	.08	.07	.06	.05	.11	.17	.14	.13	.04	.02
Arkansas.....	.03	.09	.15	.23	.13	.13	.05	.07	.03	.03	.03	.02
California.....	.11	.09	.22	.13	.10	.02	.04	.12	.04	.04	.05	.07
Colorado.....	.00	.00	.03	.03	.13	.23	.20	.21	.03	.06	.00	.00
Connecticut.....	.00	.06	.06	.22	.02	.22	.20	.11	.08	.00	.04	.00
Delaware.....	.00	.00	.11	.16	.26	.11	.11	.11	.05	.00	.05	.05
District of Columbia.....	.00	.00	.15	.23	.43	.15	.00	.00	.00	.00	.00	.00
Florida.....	.05	.13	.09	.23	.30	.12	.05	.03	.02	.00	.00	.00
Georgia.....	.02	.04	.13	.21	.22	.13	.10	.04	.02	.02	.02	.03
Idaho.....	.00	.01	.05	.23	.24	.20	.08	.08	.07	.05	.01	.00
Illinois.....	.01	.01	.10	.20	.17	.18	.11	.08	.09	.05	.00	.01
Indiana.....	.01	.01	.11	.20	.24	.17	.11	.09	.04	.01	.01	.01
Indian Territory.....	.03	.08	.31	.26	.13	.03	.00	.00	.03	.06	.10	.00
Iowa.....	.01	.00	.07	.18	.19	.18	.15	.12	.08	.03	.02	.00
Kansas.....	.00	.01	.08	.23	.20	.24	.09	.04	.08	.04	.00	.00
Kentucky.....	.01	.03	.10	.19	.17	.16	.14	.16	.02	.03	.00	.00
Louisiana.....	.05	.14	.20	.18	.14	.07	.06	.02	.00	.05	.07	.03
Maine.....	.00	.00	.03	.03	.22	.25	.13	.06	.12	.15	.00	.00
Maryland.....	.01	.00	.05	.08	.17	.12	.24	.16	.06	.05	.04	.00
Massachusetts.....	.00	.00	.04	.17	.08	.16	.25	.16	.08	.06	.01	.00
Michigan.....	.00	.00	.06	.13	.24	.16	.08	.17	.08	.07	.00	.00
Minnesota.....	.00	.00	.03	.15	.18	.24	.14	.19	.05	.01	.00	.00
Mississippi.....	.04	.13	.26	.20	.15	.11	.03	.02	.01	.01	.02	.04
Missouri.....	.02	.02	.10	.23	.16	.18	.08	.07	.06	.04	.02	.02
Montana.....	.00	.00	.02	.07	.17	.27	.32	.14	.07	.05	.00	.00
Nebraska.....	.00	.00	.04	.21	.15	.25	.14	.13	.05	.00	.01	.01
Nevada.....	.01	.00	.05	.14	.17	.14	.14	.08	.10	.10	.05	.00
New Hampshire.....	.00	.00	.02	.10	.13	.25	.18	.10	.06	.13	.02	.00
New Jersey.....	.00	.00	.06	.10	.14	.13	.16	.14	.11	.03	.09	.00
New Mexico.....	.01	.02	.04	.03	.16	.26	.14	.17	.07	.07	.02	.02
New York.....	.00	.00	.05	.12	.12	.16	.15	.14	.11	.09	.02	.00
North Carolina.....	.02	.03	.08	.14	.27	.20	.12	.06	.05	.02	.01	.01
North Dakota.....	.00	.00	.01	.12	.22	.19	.19	.15	.11	.03	.01	.00
Ohio.....	.00	.00	.07	.19	.21	.17	.12	.10	.06	.06	.01	.00
Oklahoma.....	.00	.04	.04	.39	.26	.14	.04	.01	.03	.03	.03	.00
Oregon.....	.03	.10	.16	.16	.17	.09	.05	.02	.06	.03	.07	.05
Pennsylvania.....	.00	.01	.04	.13	.19	.16	.19	.14	.08	.04	.03	.01
Rhode Island.....	.00	.00	.00	.02	.00	.00	.03	.01	.02	.00	.01	.01
South Carolina.....	.04	.09	.03	.13	.21	.22	.03	.17	.00	.04	.01	.03
South Dakota.....	.00	.00	.03	.13	.12	.30	.25	.11	.05	.02	.01	.00
Tennessee.....	.02	.02	.19	.23	.17	.14	.08	.06	.05	.02	.02	.02
Texas.....	.04	.05	.17	.23	.19	.11	.04	.04	.03	.04	.04	.03
Utah.....	.01	.03	.04	.14	.16	.17	.14	.12	.09	.09	.01	.01
Vermont.....	.00	.00	.03	.16	.11	.22	.13	.28	.07	.03	.00	.00
Virginia.....	.01	.02	.07	.15	.23	.16	.14	.10	.05	.01	.02	.00
Washington.....	.01	.07	.19	.27	.13	.06	.01	.01	.07	.10	.05	.04
West Virginia.....	.00	.01	.04	.23	.24	.17	.10	.04	.04	.08	.02	.01
Wisconsin.....	.00	.01	.04	.16	.24	.20	.13	.10	.07	.04	.01	.00
Wyoming.....	.00	.00	.02	.16	.05	.32	.22	.16	.07	.00	.00	.00

The annual frequency for each unit area, as given in the last column of Table 1, is also shown graphically on Chart X, whose numbers give a strong indication that hailstorms are less frequent in the arid regions. In the Gulf States and the Lake region, the frequency is also less than in the central States from Missouri to Ohio. The region of greatest frequency is the middle Atlantic States; in this region, the sleet is doubtless often counted as hail and occurs frequently. Moreover, as before stated, the smallness of the areas of these States renders the quotient or percentage here given liable to exaggeration. If we combine the region from Maryland to Massachusetts in one average, we have the following result:

States.	Areas in units of 10,000 square miles.	Annual frequency.	
		State.	Unit area.
District of Columbia.....	0.01	7	700
Maryland.....	1.1	97	88
Delaware.....	0.2	19	95
New Jersey.....	0.8	89	112
Connecticut.....	0.5	54	108
Rhode Island.....	0.1	10	100
Massachusetts.....	0.8	81	102
Total.....	3.5	357	102

The small percentage of 17 for Virginia seems in remarkable contrast to the frequencies in the neighboring States.

The annual periodicity of frequency of hailstorms in each State is found by dividing the monthly sums in Table 1 by the annual total. The results are expressed in decimals in Table 2, where the heavy-faced type indicates the month in which hail is most frequent in each State. The months of March, April, and May occur most frequently, December and January most unfrequently. The earliest month in the year is March for five States; the latest month is August for two States. The greatest number of hailstorms occurred in 1894, the fewest in 1895. Greatest annual number of hailstorms reported in any one State is 76 during 1894 in Colorado.

### ANEROID BAROMETERS.

By DR. CHARLES CHREE, Superintendent Kew Observatory.

In the September number of the MONTHLY WEATHER REVIEW pp. 410-412, Prof. C. F. Marvin makes several references to a paper by me, discussing experiments on aneroid barometers at Kew Observatory. I have to thank Professor Marvin for his appreciative remarks, and I should like to discuss briefly one or two of the points he raises, and first the dynamical heating or cooling of the air inside the air-pump receiver in which the experiments were made. In the apparatus used in the special experiments at Kew there are two receivers; the inner (principal) receiver contained the aneroids and a thermometer, and was in constant communication with the mercury gauge; the outer was situated between the principal receiver and the air pump, being connected with them by metal tubes furnished with stopcocks. In all the aneroid experiments the outer receiver was first suitably exhausted, and then by manipulating the cocks on the connecting tube the pressure in the principal receiver was reduced slowly and uniformly, the fastest rate being 1 inch in 5 minutes. The steadiness of the gauge after each elementary exhaustion, and the absence of any creep in the thermometer—except of course when the room temperature was changing—negated the existence of any sensible dynamical heating or cooling. This is only what we would conclude from thermodynamics having regard to the circumstances. As confirmatory I may mention that on a considerable number of occasions when the aneroids were not in the receiver I observed the effect of suddenly increasing or diminishing the pressure in the principal receiver by 5 or 6 inches in as many seconds. In this case the thermometer shows a small and rapid alteration of reading; part at least of which, however, is due to the change of the external pressure on its bulb.

As Professor Marvin draws an argument in favor of large aneroids from a remark of mine respecting the behavior of a certain group of instruments, I may say that, according to my experience, after effect is greatest on the whole in small aneroids. Still, one not infrequently finds more after effect in an individual 4½-inch aneroid than in a 1½-inch aneroid, especially when the latter covers a wide pressure range. The particular aneroids I referred to were of the largest common size, 4½-inch diameter, but in no way exceptional in that respect. Even in the case of aneroids from a single maker, the phenomena do not depend on the size alone. The fact that such variations exist without any apparent reason, so far as the maker seems to know, may appear discouraging. Biologists insist, however, that there is nothing like the existence of sports or varieties in species for facilitating the action of natural selection, and if the Kew observatory committee should find themselves in a position to lay down regulations leading to the rejection of the unfittest aneroids, I should expect very decided improvement.

I entirely agree with Professor Marvin that the ideal thing

is the total elimination of after effect, provided this should introduce no other evil. It sometimes happens, however, that the elimination of Scylla widens the jaws of Charybdis, and a careful eye should be kept on other properties.

Professor Marvin apparently considers the laws evolved in my paper too complicated for practical use. This must depend partly upon the intelligence of the observer, as well as on the ability of the individual reducing the observation. By putting, however, the aneroid used in an ascent, or a similar one previously compared with it, through an analogous series of pressure changes in a receiver, it seems possible, as explained in my paper, to reduce very largely the uncertainty of the results. The difficulty of treating the results would be much reduced if the aneroid readings at all pressures were independent of the temperature.

By a printer's error, the date of my paper is given in Professor Marvin's account as 1895 instead of 1898.

#### CIVIL SERVICE EXAMINATIONS FOR OBSERVERS IN THE UNITED STATES WEATHER BUREAU.

By H. H. KIMBALL, Weather Bureau.

It has been my privilege to assist the Civil Service Commission in marking the papers on meteorology and the essays on meteorological subjects submitted at the regular semiannual examinations, April 27 and September 27, 1898, which were held in all parts of the country in order to obtain a list of eligibles for the position of "Observer, United States Weather Bureau." Judging from these examination papers, a majority of the applicants were already connected with the Bureau either as messengers, watchmen, voluntary observers, or in some other capacity that offers opportunity for obtaining practical knowledge in meteorology. It might, therefore, not be out of place to offer a few suggestions through the pages of the MONTHLY WEATHER REVIEW to those intending to take the examination at some future date.

While the relative standing of candidates depends very largely upon the percentages made in meteorology and essay writing, it should be remembered that the examination also embraces geography, penmanship, spelling, letter writing, copying, and arithmetic. It frequently happens that a passing grade is attained in the former, only to be reduced below the standard by failure in the latter subjects. The necessity of, at least, a very thorough common school, and, if possible, high school, education is therefore apparent.

Furthermore, without a thorough knowledge of the English language and the ability to use it, born only of experience, one can not hope to write a creditable essay, or to compose his answers to the questions in meteorology so clearly that the examiners will have no doubt as to his meaning.

The meteorological papers submitted enable us to group the writers into three quite distinct classes: First, those whose papers show evidence of thorough and careful preparation, and a consequent mastery of the subject. Second, those whose papers show little or no attempt at the necessary preparation. Thus, one poor fellow wrote out all he knew about *condensation* and *precipitation* in about ten words, and acknowledged that he had no time for study. Another described the *dew-point* as a *needle point of steel*, and determined it by the *rise and fall of the barometer*; and still another described a thunderstorm as a *burning up of the carbonaceous matter and surplus nitrogen of the air*.

The first class will get along very well without any suggestions, and we have none to make to the second class further than that they cultivate the studious habit.

The third, and perhaps the largest, class of applicants is composed of those whose papers bear evidence of ill-directed and unprofitable preparation. Apparently, considerable

reading had been done, and many scientific terms had been committed to memory without any clear conception as to their significance. In fact, most of the work done has been memory work, and even the elementary principles of meteorology have been left unmastered.

Such preparation might enable one to define a *foehn* wind or a *col*, but would hardly prepare one to distinguish between climate and weather.

To such we would say that the observer's examination in meteorology, while it aims to be elementary and practical, is quite comprehensive in its character, and a mastery of the elementary principles of the subject is essential. The study of high-sounding terms and theories that are more or less speculative need not be attempted by the applicant, but may be postponed to a later period of study. Thoroughness in first principles should be the watchword; master every inch of ground that is covered, even if you do not get beyond the most elementary of books. But be sure that book is up to date, for meteorology has developed greatly in the last twenty years.

In essay writing, it is a good rule not to attempt to write about that of which one has no knowledge. A candidate who admitted that he knew nothing about the arid region of the United States and, therefore, wrote about the weather at his old home, did more creditable work than a fellow competitor who described the arid region as *a good place for bears and other animals covered with wool; but, on account of numerous icebergs, it was not a good place for navigation, for the abode of man, or for vegetation*.

The element of chance in these examinations is very small. In one way or another, a man is sure to show just how much he knows. If, therefore, he is to compete successfully with his fellows, he must thoroughly understand the subjects upon which he is to be examined, and must say no more than he is sure of.

#### CLIMATE AND CROP REPORT, SEASON OF 1898, ALASKA SECTION.

By H. L. BALL, Section Director.

The District of Alaska is nearly or quite as large as that part of the United States east of the Mississippi River. The greater part of this vast territory lies between the one hundred and thirtieth and one hundred and sixty-sixth degrees of longitude, and the fifty-second and seventy-first parallels of latitude—or, its length lies along the parallels and not longitudinally, as is the case with the Eastern States. For climate and crop study two divisions may be made: the southern coastal region, and the interior, each characterized by extreme ruggedness, often inaccessibility, and having a different climate.

The sweep of the ocean current along the whole southern coast gives that section a more temperate and uniform climate than the interior, or than would otherwise be found in such high latitudes. The presence of this warm current and the peculiarly intricate mountain system of the coast line unite to produce a climate having comparatively small temperature range and an excessive precipitation. Where it is otherwise, and sometimes such is the case, local topographic features cause the difference.

Southeastern Alaska includes all the Alexander Archipelago. This section is a labyrinth of mountainous and heavily timbered islands interlaced with numberless narrow channels. The general trend of the mountains is parallel to the coast line. Meteorological records at Sitka fairly represent the general climatic conditions prevailing throughout the section, although there are localities that show variations which are only to be accounted for by peculiar local topography.

Northwest of the Alexander Archipelago is Yakutat Bay.